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"Economic Mathematics" Innovation in Japan

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Abstract

A book entitled 'University Students who Cannot Calculate Fractions' published at the end of 1990s in Japan (edited by Okabe k. et. al, 1999) aimed to disclose the mathematical level of Japanese University Students by testing them with primary and secondary school level math quizzes. The 20% of them could not even solve fraction questions that children learn at primary school. This fact is indeed problematic for them to study Economics in higher education.

Our study thus investigated how Japanese mathematics education has improved after 20 years of this book publication by testing university students with the same math questions used in the previous survey. The results were indifferent from the previous ones proving that the mathematics education in Japan was not innovated in these 20 years.

Our paper explored what kinds of mathematical knowledge would disturb the current Japanese university students for understanding fundamental subjects such as Macro and Micro Economics. The results clarified the mathematical components they felt difficulty for understanding as well as their feelings of dislike for math. They are in the category of basic mathematical knowledge used in Economics, meaning that the education of this field is not sufficient and adequate for Japanese university students. This category is characteristic for Japanese university`s curriculum, called Economic Mathematics.

Our paper pointed out that the education of mathematical knowledge for understanding Economics including curriculums must be drastically developed. By doing so, students who do not even understand primary level fractions should be able to adequately understand Economics in higher education. As a result, our original textbook based upon the research outcomes will be created.

Keywords: Economic Mathematics, Japanese university`s curriculum, original textbook, Japanese mathematics education, Innovation

1. Introduction

1.1 Purpose

Universities in Japan offer a course called "Economic Mathematics", a type of course not available in the West. That said, even in Japan, neither clear rule nor academic conference is established for this course. In Japan, the general term for mathematics being applied to learn economics is called "Economic Mathematics", and the content of this course is being setup independently by each university and course instructor.

Especially prior to the 90's, the curriculum of economics departments in Japan required students to learn and complete macro-economics and micro economics (mid-level) under the premise of students already possessing full knowledge of mathematics being taught up to the point of high school. Because of this, when Economic Mathematics course is being taught at university level, the instructor typically skips over the basic high school math portion and goes right into exclusively discussing on advanced math contents.

During the second half of the 90's, the Economic Mathematics went through a time of innovation with the introduction of textbooks written by the authors entitled "Texisuto Keizai Sugaku" and "Nyumonhen Texisuto Keizai Sugaku". Since

then, the Economic Mathematics were being taught throughout universities across Japan through a method that combined the flow of basic mathematics and economic theory that included mathematics being taught up to high school.

Now that 15 years have passed by since the introduction of such method, we felt the need to verify whether such innovation alone was enough and whether improvement is evident in the mathematics education up to high school. In this paper, we conducted a test and questionnaire at several universities in May 2016, and we examined whether mathematics is interfering with student's study of economics and what portion of mathematics students are not comprehending. Based on the result of this study and result of the text mining study that we conducted simultaneously, not only did we discover that many students were unable to comprehend university level economics and "Economic Mathematics", but they also possessed a sense of dislike toward mathematics being taught up to high school.

In light of such findings, by giving consideration to the backdrop of economic education in Japan and analysis result of this paper, we created a textbook where students can systematically study Economic Mathematics, macro economy and micro economy in a single textbook. We would like to propose this textbook to be used in the future education of Economic Mathematics in Japan. Through this textbook, we can expect students on their own to be able to discover the significance of utilizing mathematics for their study of economics.

Based on our most recent analysis result, we decided to create "Economic Mathematics" textbook crafted through our unique innovative method that can solve issues that became apparent in this study.

1.2 Issues Surrounding a Course Called "Economic Mathematics" in Japan

In Japanese curriculum, students are not required to take advanced level of mathematics up to high school education. Further, since subjects are generally divided into liberal arts and science classes to gear up for university entrance exam, with the exception of few students, not too much emphasis is made on mathematics education especially for liberal arts oriented classes.

Many liberal arts students who are learning economics after entering into university tend to have a negative view toward the method of utilizing mathematics to analyze economy. However, unless students utilize mathematical knowledge, they will not be able to comprehend economics. As they progress their study in economics, they will inevitably run into observation made in mathematics. For this reason, students need to obtain mathematical knowledge if they want to deepen their understanding toward economics.

To understand what it means to integrate a course called "Economic Mathematics" implemented throughout universities in Japan, one must recognize that the course aims to make economical observation through the use of mathematics by treating actual mathematics as a "method to deepen the understanding of economics". Our aim is so that by learning Economic Mathematics, students from every university will be able to make expression based on math formula, and for them to further deepen their comprehension toward the principle and analysis method of economic theory, basic issues of economics and economical phenomenon.

However, although each university is under the illusion that they are teaching mathematics, macro-economics and micro economics in a systematic way, the current reality is anything but "systematic" causing liberal arts students to stall at confused state. Even if students equip themselves with mathematical knowledge, if they cannot comprehend how mathematics is being applied in economics, they will not be able to deepen their mathematical understanding toward economics, which is the primary objective behind such application in the first place. Because there is no established content called "Economic Mathematics", each instructor is teaching the subject matter through one's own method/content, thus failing to meet the goal of teaching economics systematically to university students.

1.3 Previous Research

Study was conducted between 1997-1998 to examine the mathematical level of first year university students in "Bunsu Ga Dekinai Daigakusei('University Students who Cannot Calculate Fractions')" (1999) Seiji Okabe, Shinosuke Tose, Kazuo Nishimura edition. Since the study was conducted during the time when government enacted a policy called yutori-education (pressure-free education) that forced schools to switch from packed-type education, the result showed extremely low level of scores in arithmetic and mathematics. With the consent of the authors during that time, we conducted a survey/analysis for our recent study by using the same problem exercises used at that time.

When looking at student studying math, we see cases where students base their like and dislike toward math more or less based on their emotion. To analyze this, we will use the text mining method used by Yusuke Nihei, others (2014) for their research on education. In their study, they utilized text mining for the long term practical training serving as the active learning for pharmaceutical department, and discussed on its effect and improvement. For this paper, we will apply this method to verify mathematics education.

2. Comparing Mathematical Knowledge that Existed 20 Years Ago

2.1 Creation and Purpose of Problem Exercises

"Bunsu Ga Dekinai Daigakuse" (aforementioned work) is a book that publically revealed how much elementary and junior high school level math problem exercises were being answered correctly by the Japanese university students during the second half of the 90's. The result showed that 20% of university students were unable to correctly solve fraction being taught in elementary school. Needless to say, not being able to solve an elementary school level fraction poses a serious problem for students who are attempting to learn economics at university level.

2.2 Procedure for Estimating the CES-utility Function

20 years later (which is present), we targeted university students who are considered to be at the same level as the students 20 years ago and had them solve the same problem exercises, to see if Japanese mathematics education went through any sort of innovation within last 20 years. (Note 1) The purpose of this study is to compare it with 20 years ago. Names of universities/departments are being categorized per level, and they are indicated with a symbol A~E.

1) Comparison between Universities

Main aggregate results from the survey

We conducted a test in May of this year as mentioned in the above. In this section, we will introduce its results report and main simple aggregate results of relation between affiliation and mathematics score. Table-1 and chart-1 are average scores per university, chart-2 compares average scores per university. "Higher ranking information oriented university D" scored the highest with 74.3 points, followed by "Higher ranking university B" with 72.4 points, and "Medium ranking economics oriented university E" scoring 72.2 points. When we verified the average score difference between each university by using one-way analysis of variance, it showed significant difference. （$F(4, 207.6)=2.41$, $p<0.10$）(Note 2). According to Fisher's multiple comparison that uses minimum significant difference, a significant difference was shown between "Higher ranking university B" and "Economics department of middle ranking university C", and significant difference was shown between "Economics department of middle ranking university C" and "Higher ranking information oriented university D". Based on this, we identified that a gap exists between higher ranking and middle ranking private universities.

Table 1. Average Score of Each University

Name of university/department	Sample size	Average	Standard deviation
Economic department of middle ranking university A	32	67.50	21.33
Higher ranking university B	134	72.37	22.09
Economic department of middle ranking university C	42	64.76	20.21
Higher ranking information oriented university D	142	74.28	17.88
Middle ranking economics oriented university E	45	72.18	14.27

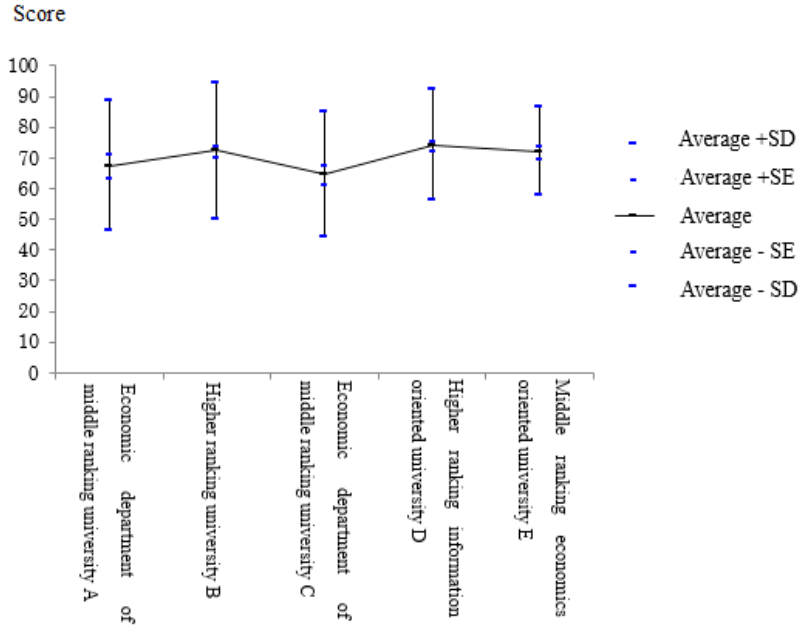

Figure 1. Average Value of Test

Table 2. Multiple Comparisons (Fisher's Minimum Significant Difference)

		Difference	P value※:P<0.05 ※ ※:P<0.01
Economic department of middle ranking university A	Higher ranking university B	4.873	0.207
Economic department of middle ranking university A	Economic department of middle ranking university C	2.738	0.552
Economic department of middle ranking university A	Higher ranking information oriented university D	6.782	0.078
Economic department of middle ranking university A	Middle ranking economics oriented university E	4.678	0.303
Higher ranking university B	Economic department of middle ranking university C	7.611	0.029 ※
Higher ranking university B	Higher ranking information oriented university D	1.909	0.419
Higher ranking university B	Middle ranking economic oriented university E	0.195	0.954
Economic department of middle ranking university C	Higher ranking information oriented university D	9.520	0.006 ※※
Economic department of middle ranking university C	Middle ranking economics oriented university E	7.416	0.079
Higher ranking information oriented university D	Middle ranking economics oriented university E	2.104	0.531

2) Compared with the past

Let us compare it with the result published in "Bunsu Ga Dekinai Daigakusei" 20 years ago.

We conducted a test in May of this year as mentioned in the above.

Private University

1999(Average score)

	Mathematics (No)	Mathematics (Yes)
Higher ranking university	67.84	93.04
Middle ranking university	55.68	91.24
Low ranking university	48.8	82.48
Survey conducted on May, 2016		

	Mathematics (No)	Mathematics (Yes)
Higher ranking university B	68.01（111 persons）	93.39（23 persons）
Middle ranking university A	61.5（312 persons）	—
Information oriented middle ranking university D	68（80 persons）	82.38（62 persons）
Economics department of middle ranking university C	60.12（32 persons）	79.60（10 persons）
Economics oriented middle university E	—	72.17（44 persons）

For higher ranking university, the average score of the recent higher ranking university scored 68.01 points, when compared with the average score of 67.84 points regarding students in 1999 who took entrance exam and did not select mathematics. On the other hand, the recent score of students who selected mathematics for entrance exam scored 93.39 points, when compared to the average score of 93.04 points in 1999. We can conclude that no change is shown here.

In contrast, for middle ranking university, students who took entrance exam with no mathematics scored 55.68 points in 1999, and they scored 60－68 points in 2016. This result can be attributed to the fact of implementing education aiming to improve the basic ability in arithmetic and mathematics following the end of yutori-education (pressure-free education).

If students cannot solve the problem exercises given by Nishimura and his team, they will have difficulty studying just about any portion of macro and micro economics. As it turns out, the recent result came out to be higher when compared to the result shown 20 years ago. We need to think about university level mathematics education in consideration of this result.

3. Where the Problem Lies for Japanese Mathematics Education—Utilize Education Related Function

3.1 Education Related Function and Its Estimation

By targeting the class that carried out the test, we conducted a survey by assuming the following function.

$$T=a+b_1X_1+b_2X_2+b_3X_3+c_1Y_1+c_2Y_2+c_3Y_3+c_4Y_4+c_5Y_5$$

Name of variable

T：Score of simulation test

Name of variable

Table 3. Used Variables

X_1 Male/female	Male	Female		
X_2 Name of university	Economics department of middle ranking university A	Higher ranking university B	Economics department of middle ranking university C	
X_3 School year	1	2	3	4
Y_1 Where you science or liberal arts course student in high school?	Liberal arts	Science	Others	
Y_2 Did you select mathematics as the entrance exam subject upon entering the school?	Yes	No	Others	
Y_3 Did you select mathematics III during high school years?	Yes	No	Others	
Y_4 Do you find mathematics difficult?	Yes	No	Neither	
Y_5 Would you like to engage in economics by first reviewing the basic mathematics during the lecture?	Yes	No		

3.2 Estimated Result Analysis of Education Related Function

Let us look at the type of education related function that affects mathematics ability.

In the below, we will make verification by conducting multiple regression analysis that recognizes test score as dependent variable.

To see what kind of impact education related function have on the mathematical ability, we will use education related dummy variable as independent variable. For control variable, in addition to variable pertaining to university attribution and school year, we will also throw in individual attribution. Table 4 shows a descriptive statistics of variable used for analysis, and table 4 shows the result. The result showed significance in "high school: others", "entrance exam: selected mathematics", "entrance exam: others" and "I find mathematics difficult". It became clear that there is a distinctive gap between scores based on mathematics education.

Table 4. Descriptive Statistics

Name of variable	Average	Standard deviation	Maximum value	Minimum value
Test score	70.09	21.69	100	20
School year	1.45	0.78	4	1
Male ※	0.70	0.46	1	0
Higher ranking university B※	0.64	0.48	1	0
Economic department of middle ranking university A※	0.15	0.36	1	0
Economic department of middle ranking university C※	0.20	0.40	1	0
High school: Science※	0.14	0.35	1	0
High school: Liberal arts※	0.80	0.40	1	0
High school: Others ※	0.06	0.24	1	0
High school: Mathematics III selection※	0.16	0.37	1	0
Entrance exam: Selected mathematics※	0.73	0.45	1	0
Entrance exam: Did not select mathematics ※	0.73	0.45	1	0
Entrance exam: Others ※	0.08	0.27	1	0
I find mathematics difficult ※	0.56	0.50	1	0
I neither find mathematics easy nor difficult ※	0.24	0.42	1	0
I don't find mathematics difficult ※	0.20	0.40	1	0
I want to review basic mathematics	0.72	0.45	1	0

Note (1) Sample size is 208

Note (2) ※ is dummy variable

Table 5. Impact Education Related Variable Have on Mathematics Ability (Multiple Regression Analysis)

Dependent variable = test score
Sample size = 208
Revision R2 power = 0.312

Name of variable	Coefficient value	P value	
Constant term	95.898	0.000	***
School year	-4.800	0.154	
Male	6.217	0.026	*
Higher ranking university B	1.940	0.703	
Economics department of middle ranking university A	-2.229	0.404	
(Economics department C of middle ranking university)			
High school: Science	3.388	0.472	
(High school: liberal arts)			
High school: Others	-12.134	0.028	*
High school: Mathematics III selection	2.096	0.643	
Entrance exam: Selected mathematics	-14.542	0.000	***
(Entrance exam: Did not select mathematics)			
Entrance exam: Others	-17.130	0.002	**
I find mathematics difficult	-17.083	0.000	***
(I neither find mathematics easy nor difficult)			
I don't find mathematics difficult	-4.704	0.237	
I want to review basic mathematics	-2.357	0.412	

Note (1) Based on author's estimation

Note (2) ※ is 5%, ※※is 1%, ※※※ is significance with 0.1% standard

3.3 Examining the Mathematics Up to High School-Text Mining Analysis

We asked the following questions to 140 higher ranking university students

Question:

"Do you like or dislike mathematics? (or neither)". Write down any of the below 「」item at the beginning of the sentence, and write down your feeling toward mathematics between 100 to 200 words by including the element being specified in each section.

We instructed students to write down their reason for 「like」, reason for 「dislike」, area/portion they understand, area/portion that they find difficult, and for 「neither」, area/portion they understand and area/portion that they find difficult. As the result, we obtained response from 90 students. The response came out as follows.

90 students by combining 「like」『dislike』「neither」

Like 30

Neither 23

Dislike 37

When we analyzed frequently used words through text mining, we obtained the following result.

We used free "text mining" tool provided by User Local Inc.

Noun

	Like		Dislike		Neither	
Order of frequency	Word	Number of occurrences	word	Number of occurrences	Word	Number of occurrences
1	Mathematics	100	Mathematics	74	Mathematics	58
2	Like	41	Find it difficult	52	Like	24
3	Things	30	Understand	44	Find it difficult	24
4	Answer	24	Area	40	Problem	23
5	Problem	23	Thing	40	Area	21
6	One	15	Problem	25	Thing	19
7	Study	14	Dislike	23	Strong point	17
8	Reason	13	High school	22	Dislike	15
9	Strong point	13	Calculation	21	Understand	13
10	Find it difficult	12	Class	16	Study	11

Verb

	Like		Dislike		Neither	
Order of frequency	Word	Number of occurrences	Word	Number of occurrences	word	Number of occurrences
1	To engage	72	Capable	60	To engage	38
2	Necessary	43	To do	59	necessary	30
3	Is	31	Become	46	Capable	23
4	Become	27	Necessary	38	Become	22
5	Capable	14	Is	28	Is	20
6	Think	14	Think	26	Solove	11
7	Solve	13	Put away	21	Think	11
8	Go	11	To do	14	Go	10
9	Think	9	Go	10	Put away	8
10	Use	9	Feel	9	Memorize	7

Adjective

	Like		Dislike		Neither	
Order of frequency	Word	Number of occurrences	Word	Number of occurrences	Word	Number of occurrences
1	No	10	Difficult	12	No	13
2	Fun	8	No	8	Fun	8
3	Difficult	6	Many	7	Difficult	8
4	Few	3	Quick	4	Strong	3
5	Many	3	Long	3	Deep	3
6	Glad	3	Well	2	Many	2
7	Well	2	Fast	2	Cheap	2
8	Long	2	Few	2	Small	1
9	Good	2	Easy	2	Skilled	1
10	High	2	Small	2	Feels good	1

We will analyze by excluding 「like」「dislike」「find it difficult」「reason」「area」and general 「mathematics」that we instructed students to write down as the content.

3.3.1 Analysis of Noun

Words “high school” and “class” pops up on “dislike” item. This indicates that high school and high school classes are somewhat tied to student’s dislike tendency. Further, the word “calculation” pops up in the “dislike” item. We believe calculation is the cause behind why students find mathematics difficult. In mathematics, even if students have a correct theory, they will still be marked as having an incorrect answer if they miscalculate their theory. Naturally, if students are not good at calculating, they tend to be bad at mathematics.

3.3.2 Analysis of Verb

Although “thinking” and “solving” are included in “like” and “neither”, these words are not included in “dislike”. Since “thinking” is a crucial aspect in mathematics, we assume students who are willing to “think” and “solve by thinking” are naturally more inclined to find mathematics interesting. Students who dislike mathematics tend to be bad at conceptualizing things through mathematical thinking.

3.3.3 Analysis of Adjective

Word “fun” popped up as the common frequent word for “like” and “neither”, and “difficult” popped up as a frequent word for “dislike”. In the case of students being good at mathematics (as well as liking it), we assume their positive feeling toward the subject is more or less based on their emotions. We assume “students who like mathematics” actively reflected by verbs such as “thinking” and “solving” are a type of students who like to conceptualize things through mathematical thinking mode.

In contrast, students who dislike mathematics view it as a “difficult” subject based on their preconceived notion. Because of this, even easy concept becomes “difficult” due to their emotional wiring.

4. Innovation of Economic Mathematics in Japan—Creating new textbook for Economic Mathematics education

“Tekisuto Keizaigaku(Textbook of Economic Mathematics)” and “Nyumon Tekisuto Keizaisugaku(Textbook of Introduction to Economic Mathematics)” that were published a while back received a high praise, and even now, there is a high necessity for these textbooks. In this mathematical basic ability study, we confirmed that basic ability was being improved. In consideration of this study, by revising the existing method explained in details based on mathematical knowledge, we decided to create a textbook that mainly focuses on items such as differential and partial differential (considered a crucial concepts in learning economics), and logarithms that students did not learn in high school.

As obvious as it may sound, basic knowledge of mathematics should never be neglected. As one example of this mathematics basic ability study, let us now look at the percentage of correct answers for question 20：(21)、(22) (This is a question that assess basic knowledge of exponentiation indicated in appendix)

Percentage of correct answers for question 20：(21)、(22)

	(21)	(22)
Higher ranking university B	31.5％	61.5％
Middle ranking university C	33.3％	50％

Other universities equally showed low scores. In light this, for our new textbook, we revised the content of mathematical basic knowledge written in the previous two textbooks, and we decided to teach from the basics by setting up chapters on exponentiation and exponent.

As the result, we integrated each theme that were differentiated in the previous two text books, and along with systemizing the foundation of economy mathematic, for economics examples, we included respective system for macro economics and micro economics. Through these efforts, we were able to create a type of textbook in which students can systematically learn Economic Mathematics, macro economics and micro economics through a single textbook. The Economic Mathematics textbook serving as an innovative force in Japan is composed as follows:

Economic Mathematics new textbook Table of content

1. Fundamental concepts of mathematics
2. Differential
3. Partial differential
4. Fundamental concepts of differential/partial differential used in economics
5. Exponent/logarithm
6. Matrix

Appendix 1: Micro economics

Students can learn the entire foundation of micro economics by referring to the examples of micro economics in the text.

Appendix 2: Macro economy

Students can learn the entire foundation of macro-economics by referring to the examples of macro economics in the text.

As mentioned in the above, this text book is unique in a sense that the examples inserted in the text makes a clear distinction between "macro" and "micro", and students can systematically learn the Economic Mathematics, macro economics and micro economics through a single text book (combined with appendix). (Note 3) As stressed in the previous textbook, a link between economic theory remains to be a crucial point that cannot be missed. In the previous textbooks, they systemized micro theory in "Texisuto Keizaisugaku" and macro theory in "Nyumon Texisuto Keizaisugaku" so that students can simultaneously learn the entire basic portion and mathematical knowledge utilized in that portion. For this new textbook, we expand it so that students can learn the basic portion of both micro and macro economics in a single set. The result of text mining showed that students who dislike mathematics are bad at "thinking". This new textbook will provide opportunity to these types of students to be able to conceptualize their thinking based on basic economic theory. We focused on both aspects so that not only will students who are learning Economic Mathematics be able to simultaneously learn micro economics and macroeconomics, but so that students who are learning micro economics and macroeconomics will also be able to simultaneously learn Economic Mathematics as well. By advancing through the method of bringing economics theory and mathematics closer together, and by deepening student's knowledge through the mutual work of having them engage in input work of reading textbook and output work of solving exercise problems on their own, we can expect students to be equipped with observational skill grounded in economics that utilizes mathematics. This textbook inaugurates the introduction of new form of Economic Mathematics textbook in Japan. We recommend instructor at university that showed significant gap between average math test score to tweak their teaching style based on this textbook.

5. Summary

For our analysis, we compared mathematical basic academic skills with the preceding study, made estimation regarding education related function, and conducted text mining. When we examined the mathematical basic academic skills at several universities by using the same problem exercises being used in the preceding study "Bunsu Ga Dekinai Daigakuse" (aforementioned work), we were able to confirm that the basic academic skills have improved based on the trend of scores. In addition, based on the estimation result of education related function, we were able to identify the kind of factors that have an impact on the score of this study. In particular, a variable called "bad at mathematics" showed significance. Accordingly, through text mining, we analyzed the feeling of students toward mathematics (like/dislike/neither) and frequently used words that were related. The result showed that students who answered like/neither toward mathematics frequently popped up key words such as "thinking", "solving" and "fun", and students who dislike mathematics showed link to words such as "high school", "class", "calculation", "difficult". In other words, the result indicates that students who find mathematics difficult developed their awareness of not being good at mathematics during their elementary to high school days of math class.

Students who dislike mathematics will benefit from hearing explanation that carefully narrows its focus on mathematics only required for micro economics and macro-economics. Through this method students will be able to set a goal by pursuing economics theory that corresponds to mathematics, and they will be able to learn economics in a systematic way. Although this textbook tends to place a spot light on students who are bad at mathematics, it also provides great advantage to students who like mathematics. The reason is that even though students who like mathematics are good at making actual calculation, they tend to be poor at trying to comprehend the economic theory behind such calculation. This new "Economic Mathematics" textbook that proposes the bidirectional nature of covering both Economic Mathematics and economics theory, is sure to present one of a kind opportunity to these math loving students to be able to explain how mathematics is serving its useful purpose in learning economics. This new textbook is arranged in a way so that both students who like and dislike mathematics can learn the basics of micro economics and macro economics alongside learning Economic Mathematics, and vice versa (meaning they can learn Economic Mathematics alongside learning micro economics and macro-economics). We believe creating this type of "Economic Mathematics" textbook will solve Japan's existing problems surrounding "Economic Mathematics", and it will serve as an innovative force that can contribute toward presenting better education to students in Japan.

Addendum

These are problem exercises used in the test（Note 4）

Question 1:

$$\frac{7}{8}-\frac{4}{5}=(1)$$

Question 2:

$$\frac{1}{6}\div\frac{7}{5}=(2)$$

Question 3:

$$\frac{8}{9}-\frac{1}{5}-\frac{2}{3}=(3)$$

Question 4:

$$3\times\{5+(4-1)\times 2\}-5\times(6-4\div 2)=(4)$$

Question 5:

$$2\div 0.25=(5)$$

Question 6:

$$-5\times\{8-10\div(-5)\}=(6)$$

Question 7:

$$\sqrt{64}=(7)$$

Question 8:

$$\sqrt{3}\times\sqrt{27}=(8)$$

Question 9:

$$\big||-1|-|-3|\big|=(9)$$

Question 10:

When its $3x+1=7$, $x=(10)$

Question 11:

x, and y that satisfies $\begin{cases}3x+y=17\\2x-5y=3\end{cases}$, is $x=(11), y=(12)$

Question 12:

Range of x that satisfies $3x+1<4$ is (13)

Question 13:

Range of x that satisfies $\begin{cases}2x+3<2\\3x+1>-5\end{cases}$ is (14)

Question 14:

x that satisfies $3x^2-5x-2=0$, is $x=(15)$

Question 15:

x that satisfies $x^2+2x-4=0$, is $x=(16)$

Question 16:

When its $17xy+7=19xy$, $4xy=(17)$

Question 17:

When its $\frac{1}{2x-1}=\frac{1}{9}$, $x=(18)$

Question 18:

When its $|x+1|=3$, $x=(19)$

Question 19:

Show the range of (x, y) that satisfies $\begin{cases} y \leq 3x - 2 \\ x \geq 0 \end{cases}$

Question 20：

Let us assume $y = 2^{-x}$. When x=0, then y= (21), when x=3, then y = (22).

Question 21：

Let us consider point A(5,-2), point B(3,6).

I. The coordinate of mid point of line segment AB is (23).

II. The coordinate of point AC:BC=2:1 which is point C on line segment AB is (24)

III. The length of line segment AB is (25).

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Notes

1. In regard to the writing of this paper by using the same problem exercises and reporting to various conferences, we gained the approval of Dr. Kazuo Nishimura who is the main author of "Bunsu Ga Dekinai Daigakusei"

2. The result of dispersion analysis is expressed in the format "F (degree of freedom between groups, degree of freedom within group) = F value". For analysis method, we used Brown-Forsythe.

3. When using the text book, teach students that combining basic mathematics and systematic economics theory is also being utilized effectively for exclusive study of Japanese industry activation model conducted by the authors.

4. These are problems exercises that were used in Seiji Okabe, Shinosuke Seto, Kazuo Nishimura, edition (1999).